WRITTEN AMENDMENT

(AMENDMENT UNDER THE REGULATIONS IN ARTICLE 11)

COMMISSIONER OF PATENTS

1. PCT Application No. PCT/JP2004/013975

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4. PARTS TO BE
AMENDED: Specification and the Scope of Claims

5. DETAILS OF AMENDMENT

1) "visual effects (flickers) generated in the image conversion according to the 2:3 pull-down method" recited in Lines 2-3, Page 11 of the specification is amended to "visual effects generated in displaying a film image at an image conversion cycle according to the 2:3 pull-down method".

2) "The visual effects obtained in displaying the film image are hereinafter referred to as film image effects, and the image conversion cycle according to the 2:3 pull-down method is hereinafter referred to as 2:3 pull-down cycle." is added subsequent to Line 6, Page 11 of the specification.

3) "the visual effects (flickers) generated in the image conversion according to the 2:3:3:2 pull-down method" recited in Line 33, Page 12 to Line 3, Page13 is amended to "the film image effects based on an image conversion cycle according to the 2:3:3:2 pull-down method".

4) "The image conversion cycle according to the 2:3:3:2 pull-down method is hereinafter referred to as 2:3:3:2 pull-down cycle." is added subsequent to Line 4, Page 13 of the specification.

5) "the 2:3 pull-down method or" recited in Line 3, Page 15 of the specification is amended to "the 2:3 pull-down cycle or".

6) "the cycle of the 2:3:3:2 pull-down method" recited in Lines 3-4, Page 15 of the specification is amended to "the "2:3:3:2 pull-down cycle".

7) "described visual effects" recited in Line 7, Page 15 of the specification is amended to "film image effects".

8) # This amendment cannot be reflected on the English specification. #

9) "image" recited in Line 23, Page 16 of the specification is amended to "film image".

10) "video signal with the visual effects obtained in the

conversion method according to the 2:3 pull-down method in the pseudo manner" recited Lines 31-32, Page 18 of the specification is amended to "60I video signal with the film image effects based on the 2:3 pull-down cycle in the pseudo manner.

11) "visual effects according to the 2:3 pull-down method in the pseudo manner" recited in Lines 1-2, Page 20 is amended to "film image effects based on the 2:3 pull-down cycle in the pseudo manner".

12) "visual effects according to the 2:3 pull-down method in the pseudo manner" recited in Lines 16-17, Page 20 is amended to "film image effects based on the 2:3 pull-down cycle in the pseudo manner".

13) "visual effects according to the 2:3 pull-down method in the pseudo manner" recited in Lines 26-27, Page 20 of the specification is amended to "film image effects based on the 2:3 pull-down cycle in the pseudo manner".

14) "visual effects according to the 2:3 pull-down method in the pseudo manner" recited Lines 14-15, Page 21 of the specification is amended to "film image effects based on the 2:3 pull-down cycle in the pseudo manner".

15) "visual effects (flickers) generated in the image conversion according to the 2:3 pull-down method" recited in Lines 10-13, Page 22 of the specification is amended to "film image effects based on the 2:3 pull-down cycle".

16) "visual effects (flickers) generated in the image conversion according to the 2:3:3:2 pull-down method" recited in Lines 30-32, Page 23 is amended to "film image effects based on the 2:3:3:2 pull-down cycle".

17) visual effects generated in the image conversion according to the 2:3 pull-down method" recited in Lines 2-3, Page 24 of the specification is amended to "film image effects based on the 2:3 pull-down cycle".

18) "visual effects according to the control value (gain)

2:3:3:2 pull-down method in the pseudo manner" recited in Lines 13-15, Page 24 of the specification is amended to "film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner".

19) "visual effects according to the 2:3:3:2 pull-down method in the pseudo manner" recited in Lines 29-30, Page 24 of the specification is amended to "film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner".

20) "visual effects according to the 2:3:3:2 pull-down method in the pseudo manner" recited in Lines 7-8, Page 25 of the specification is amended to "film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner".

21) "visual effects according to the 2:3:3:2 pull-down method in the pseudo manner" recited in Lines 29-30, Page 25 of the specification is amended to "film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner".

22) # This amendment cannot be reflected on the English specification. #

23) "visual effects (flickers) generated in the image conversion according to the 2:3:3:2 pull-down method" recited in Lines 26-28, Page 26 of the specification is amended to "film image effects based on the 2:3:3:2 pull-down cycle".

24) "visual effects generated in the 24P video signal and the video signal obtained by converting the 24P video signal into the 60I video signal (60I video signal)" recited in Lines 18-21, Page 29 of the specification is amended to "film image effects".

25) "visual effects generated in the 24P video signal and a video signal obtained by converting the 24P video signal into a 50I video signal (50I video signal)" recited in Lines 24-26, Page 29 of the specification is amended to "a film image effects".

26) "be easily vested with the visual effects described earlier" recited in Line 18, Page 32 of the specification is

amended to "be vested with the film image effects in the pseudo manner".

27) "visual effects in the projected image according to the pull-down methods can be generated in the pseudo manner" recited in Lines 12-14, Page 34 of the specification is amended to "film image effects can be generated in the pseudo manner".

28) "visual effects in the projected image according to the pull-down methods to the video signal in the pseudo manner" recited in Lines 19-21, Page 34 of the specification is amended to "film image effects in the pseudo manner".

29) "visual effects in the projected image according to the 2:3:3:2 method in the 60I video signal in the pseudo manner" recited in Lines 25-26, Page 34 of the specification is amended to "film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner".

30) "visual effects in the projected image according to the 2:3:3:2 pull-down method are generated in the pseudo manner" recited Line 32, Page 34 to Line 1, Page 35 of the specification is amended to "film image effects are generated based on the 2:3:3:2 pull-down cycle in the pseudo manner".

31) "visual effects in the projected image according to the 2:3:3:2 pull-down method in the pseudo manner" recited in Lines 3-5, Page 35 of the specification is amended to "film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner".

32) "visual effects in the projected image according to the 2:3:3:2 pull-down method in the pseudo manner" recited in Lines 7-9, Page 35 of the specification is amended to "film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner".

33) "visual effects in the projected image according to the 2:3:3:2 pull-down method in the pseudo manner" recited in Lines 10-12, Page 35 of the specification is amended to "film image

effects based on the 2:3:3:2 pull-down cycle in the pseudo manner".

34) # This amendment cannot be reflected on the English specification. #

35) "visual effects in the projected image according to the 2:3:3:2 pull-down method are generated in the pseudo manner" recited in Lines 23-24, Page 35 of the specification is amended to "film image effects are generated based on the 2:3:3:2 pull-down cycle in the pseudo manner".

36) "when the present invention is applied in the 2:3:3:2 pull-down method" recited in Lines 30-31, Page 35 of the specification is amended to "when the film image effects are generated based on the 2:3:3:2 pull-down cycle in the pseudo manner".

37) "setting a gain control value of the gain controller" recited in Claim 1 on Page 37 is amended to "setting a gain control value of the gain controller to a predetermined value previously memorized".

38) "gain-controls the respective minimum video units constituting the respective video blocks resulting from the division based on the gain control value" recited in Claim 1 on Page 37 is amended to "periodically controls the gains of the respective minimum video units constituting the respective video blocks resulting from the division based on the gain control values".

39) "The video signal processing device as claimed in Claim 1, wherein" in Claim 2 on Page 37 is amended to "A video signal processing device comprising a gain controller for gain-controlling a digitalized video signal per minimum video unit, and a variation controller for setting video blocks each comprising a plurality of minimum video units and setting a gain control value of the gain controller in each the minimum video units constituting the set video blocks, wherein the gain

controller serially divides the video signals into the video blocks and gain-controls the respective minimum video units constituting the respective video blocks resulting from the division based on the gain control values, wherein", so that the relevant claim can be an independent claim.

40) New Claim 13 is added to the Scope of Claims.

6. List of Attached Documents

13. The video signal processing device as claimed in Claim 1, wherein

the variation controller sets two gain control values having values different to each other, and

the gain controller periodically changes the gains of the respective minimum video units by alternately setting the two gain control values having values different to each other in accordance with the period of the control.

First, a control operation in the case of generating in the pseudo manner the visual effects generated in displaying a film image at an image conversion cycle according to the 2:3 pull-down method is described referring to Fig. 2. In the present case, video blocks A comprising five fields are set in the variation controller 13. The visual effects obtained in displaying the film image are hereinafter referred to as film image effects, and the image conversion cycle according to the 2:3 pull-down method is hereinafter referred to as 2:3 pull-down cycle.

As shown in the control value (gain) 23 in Fig. 2, in the respective video blocks A1 (each comprising the five fields) constituting the 60I input video signal 22, first and second groups of fields are set as a minimum video unit group $A1_1$, and the gain control value of each field is set in the variation controller 13 so that the gain can be 1.0 times in comparison to a luminance signal of the input vide signal in the minimum video unit group $A1_1$. Further, third, fourth and fifth groups of fields in the respective video blocks A1 are set as another minimum video unit group $A1_2$, and the gain control value of each field is set in the variation controller 13 so that the gain can be 0.9 times in comparison to the luminance signal of the input vide signal in the minimum video unit group $A1_2$. Because the gain control value is differently set in the minimum video unit groups $A1_1$ and $A1_2$, the variation controller 13 is constituted as follows. The variation controller 13 comprises a cyclic counter 13a for repeatedly counting the five fields of 1 - 5. The cyclic counter 13a repeatedly provides count values of (1) - (5) for the respective fields constituting the 60I input vide signal 22. The cyclic counter 13a counts up the values at every both edges (that are variation points) of the frame synchronous signal 21. The variation controller 13 recognizes the respective video blocks A1 based on the count

values counted up by the counter 13a and determines the field positions in the respective video blocks A1. Further, the variation controller 13 judges if the relevant field is included in the minimum video unit group $A1_1$ or in the minimum video

unit group $A1_2$ based on the determined field positions, and sets the gain control value based on a result of the determination.

The variation controller 13 sets the gain control value by repeating the foregoing control routine. Below is given a more detailed description.

A correspondence relation between the count value of the cyclic counter 13a and the gain adjustment amount of the gain controller 14 is previously set based on the setting of the minimum video unit groups $A1_1$ and $A1_2$. The variation controller 13 memorizes the correspondence relation between the set gain adjustment amount and count value (minimum video unit groups $A1_1$ and $A1_2$). In the case of adjusting the luminance in accordance with the 2:3 pull-down method, the correspondence relation memorized by the variation controller 13 is as follows. In the case of the minimum video unit groups $A1_1$ showing count values (1) and (2), the variation controller 13 sets the gain adjustment amount of 1.0 times. In the case of the minimum video unit groups $A1_2$ showing count values (3), (4) and (5), the variation controller 13 sets the gain adjustment amount of 0.9 times. The control routine is repeated so that the gain adjustment amounts are set.

The gain controller 14 actually controls the gain in accordance with the gain control value set by the variation controller 13. More specifically, the gain controller 14 multiplies the luminance signal of the 60I input video signal 22 inputted from the input terminal 11 for the 60I video signal by the set gain control value to thereby change the gain of the video signal. Thus, the gain of the luminance signal is controlled for every two fields and three fields (see Fig. 2) corresponding to the 2:3 pull-down cycle.

Next is described a control operation in the case of generating in the pseudo manner the film image effects based

on an image conversion cycle according to the 2:3:3:2 pull-down method referring to Fig. 3. In the present case, video blocks A2 comprising ten fields are set in the variation controller 13. The image conversion cycle according to the 2:3:3:2 pull-down method is hereinafter referred to as 2:3:3:2 pull-down cycle.

As shown in the control value (gain) 33 shown in Fig. 3, in the respective video blocks A2 (each comprising the five fields) constituting the 60I input video signal 32, first, second, sixth, seventh and eighth groups of fields are set as a minimum video unit group $A2_1$, and the gain control value of each field is set in the variation controller 13 so that the gain can be 1.0 times in comparison to the luminance signal of the input vide signal in the minimum video unit group $A2_1$. Further, third, fourth, fifth, ninth and tenth groups of fields in the respective video blocks A2 are set as another minimum video unit group $A2_2$, and the gain control value of each field is set in the variation controller 13 so that the gain can be 0.9 times in comparison to the luminance signal of the input vide signal in the minimum video unit group $A2_2$.

Because the gain control value is differently set in the minimum video unit groups $A2_1$ and $A2_2$, the variation controller 13 is constituted as follows. The variation controller comprises a cyclic counter 13a for repeatedly counting the ten fields of 1 - 10. The cyclic counter 13a repeatedly provides count values of (1) - (10) for the respective fields constituting the 60I input vide signal 22. The variation controller 13 recognizes the respective video blocks A2 based on the count values counted up by the cyclic counter 13a and determines the field positions in the respective video blocks A2. The variation controller 13 judges if the relevant field is included in the minimum video unit group $A2_1$ or in the minimum video unit group $A2_2$ based on the determined field positions, and sets the gain

control value based on a result of the determination.

The variation controller 13 sets the gain control value

cycle of 1/24 second. The video signal processing device according to the present invention generates the flickers in accordance with the 2:3 pull-down cycle or the 2:3:3:2 pull-down cycle.

Thereby, even when the input video signal is 60I video signal, the output video signal thereof (60I video signal) can be easily provided with the film image effects (flickers generated based on the cycle of 1/24 second). The visual effects mentioned here are, as described earlier, such visual effects that can be visually recognized by a viewer when the 24P video signal is displayed and still remain when the 24P video signal is converted into the 60I video signal.

The video signal processing device according to the present invention realizes the visual effects without providing a plurality of field memories and by executing such a relatively simple control operation as adjusting the gain in accordance with the counted number of the fields.

When the luminance (gain) is adjusted based on the cycles of the 2:3 pull-down method and the 2:3:3:2 pull-down method, it is unavoidable for the variation points of the luminance (gain) to be located across the frames of the 60 video signal. For example, in the 2:3 pull-down cycle shown in Fig. 2, the variation points of the luminance (gain) are located between the fifth field and the sixth field and between the seventh field and the eighth field, which respectively constitute the same frames. In the 2:3:3:2 pull-down cycle shown in Fig. 3, the variation point of the luminance (gain) is located between the fifth field and the sixth field constituting the same frame in the same manner. The serial numbers of the fields are serially given to the 60I input video signals 22 and 32 in the chronological order in Figs. 2 and 3, and do not represent the order in which the fields are arranged in the minimum video unit group.

The fields result from the division of the frame.

Therefore, the viewer may sense some visual problem when the luminance levels of the fields constituting the same frame are different.

Below is described a control operation in order to eliminate the variation points of the luminance (gain) at such positions that may generate the visual problem. As shown in Fig. 4, the adjustment cycle of the luminance (gain) is set to 1/30 second synchronizing with the frame synchronous signal 310 of the 60I input video signal 320. Then, the luminance (gain) is adjusted based on the set adjustment cycle of 1/30 second. The cycle in which the luminance is changed thereby corresponds to a frame period of the 60I video signal. Therefore, the visual problem is eliminated since the positions of the variation points of the luminance (gain) correspond to the frame period (30 Hz) of the 60I video signal. In this case, video blocks A3 each comprises four fields, and a minimum video unit group $A3_1$ includes first and second fields in the video block A3, while another minimum video unit group $A3_2$ includes third and fourth fields in the video block A3.

In the case of executing the described gain control, the cycle in which the luminance (gain) is changed (cycle in which the flickers are generated) is 1/30 second, and such visual effects that can be obtained when the film image of 30 frames per second is viewed, which are similar to those according to the present embodiment, can be obtained. However, the obtained cycle is slightly shorter than 1/24 second, which is the originally desired cycle in which the luminance (gain) is changed. Because a difference between the two cycles is relatively small despite the disadvantage, the foregoing control operation may be executed when it is the highest priority to eliminate the variation points of the luminance at such positions that may generate the visual problem.

In the foregoing control operation, the cyclic counter

corresponding to the cycle of 1/30 second.

EMBODIMENT 2

Fig. 5 is a block diagram illustrating a constitution of a video signal processing device according to an embodiment 2 of the present invention. Figs. 6 and 7 are respectively timing chart showing statuses of signal conversions corresponding to the 2:3 pull-down method and the 2:3:3:2 pull-down method.

Referring to reference numerals shown in Fig. 5, 41 denotes an input terminal for the 60I video signal, 42 denotes an input terminal for a frame synchronous signal of the 60I video signal, 43 denotes a field memory, 44 denotes a selector, 45 denotes memory controller, 46 denotes a gain controller, 47 denotes a variation controller, and 48 denotes an output terminal for the 60I video signal.

Referring to reference numerals shown in Fig. 6, 51 shows a timing of the frame synchronous signal of the 60I video signal, 52 shows a timing of the 60I video signal, 53 shows a write control timing with respect to the field memory 43, 54 shows a read control timing with respect to the field memory 43, 55 shows a timing of a video output signal from the selector, and 56 shows a timing for controlling a control value.

Referring to reference numerals shown in Fig. 7, 61 shows a timing of the frame synchronous signal of the 60I video signal, 62 shows a timing of the 60I video signal, 63 shows a write control timing with respect to the field memory 43, 64 shows a read control timing with respect to the field memory 43, 65 shows a timing of the video output signal from the selector, and 66 shows a timing for controlling the control value.

Below is described a control operation by the video signal processing device. First, a control operation for vesting the 60I video signal with the film image effects based on the 2:3 pull-down cycle in the pseudo manner

to be written. In the case of attaining the film image effects based on the 2:3 pull-down cycle in the pseudo manner, the count values to be written are (1) and (3).

The memory controller 45 outputs an instruction for writing the 60I input video signal 52 to the field memory 43 at such a timing that the count value of the 60I input video signal 52 supplied by the cyclic counter 45a is a count value showing the field to be written. The instruction for writing the 60I input video signal 52 is supplied to the field memory 43 as the write control signal 53 with respect to the field memory shown in Fig. 6.

The count values of the cyclic counter 45a showing timings of the read operation with respect to the field memory 43 are previously set, and the memory controller 45 memorizes the set count values showing the timings of the read operation. In the case of imparting the film image effects based on the 2:3 pull-down cycle in the pseudo manner, the count values showing the timings of the read-operation are (2), (4) and (5).

The memory controller 45 outputs an instruction for the read operation to the field memory 43 at such a timing that the count value supplied by the cyclic counter 45a is a count value showing the timing of the read operation. The instruction for the read operation is supplied to the field memory 43 as the read control signal 54 with respect to the field memory shown in Fig. 6.

In the case of imparting the film image effects based on the 2:3 pull-down cycle in the pseudo manner, the memory controller 45 instructs the write of the 60I input video signal 52 in the field memory 43 at, for example, at such timings that the count value of the cyclic counter 45a shows (1) and (3). At such timings that the count value of the cyclic counter 45a shows (2), (4) and (5), the memory controller 45 instructs the read operation with respect to the field memory 43.

The selection of the output by the selector 44 is controlled by the count value of the cyclic counter 45a. A linkage between the count value of the cyclic counter 45a and the output selection of the selector 44 is previously set, and the memory controller 45 memorizes the set linkage.

The 60I input video signal 52 and the output read from the field memory 43 are inputted to the selector 44. The memory controller 45 controls the selector 44 based on the field count value of the 60I input video signal 52 supplied by the cyclic counter 45a. More specifically, the memory controller 45 controls the selector 44 so that the 60I input video signal 52 and the output read from the field memory 43 are selectively outputted.

In the case of imparting the film image effects based on the 2:3 pull-down cycle in the pseudo manner, the linkage memorized by the selector 44 is as follows. The selector 44 selects the 60I input video signal 52 inputted to the input terminal 41 for the 60I video signal when the count values are (1) and (3), while selecting the output read from the field memory 43 when the count values are (2), (4) and (5).

Therefore, at such timings that the write operation is being executed to the field memory 43 (at such timings that the count value of the cyclic counter 45a shows (1) and (3)), the selector 44 selects the 60I input video signal 52 from the input terminal 41 and outputs it. At such timings by which the read operation is being executed to the field memory 43 (at such timings that the count value of the cyclic counter 45a shows (2), (4) and (5)), the selector 44 selects the output read from the field memory 43 and outputs it. Thereby, the selector 44 repeatedly outputs the 60I video signal already written in the field memory 43 until the write of the next video signal is executed as shown in the video signal 55 outputted from the selector in Fig. 6.

The variation controller 47 sets the gain control value with respect to the gain controller 46 based on the frame synchronous signal 51 of the 60I input video signal 52 inputted to the input terminal 42. At the time, the variation controller 47 changes the gain control value per field, and sets the gain control value so that the gain control value is changed when the video signal outputted from the selector 44 is different to the video signal of the field immediately before. Below is given a more detailed description.

In the case of imparting the film image effects based on the 2:3 pull-down cycle in the pseudo manner, the variation controller 47 sets video blocks A4 each comprising five fields.

As shown in the control value (gain) 56 in Fig. 6, in the respective video blocks (each comprising the five fields) A4 constituting the 60I input video signal 52, first and second groups of fields are set as a minimum video unit group $A4_1$, and the gain control value of each field is set in the variation controller 47 so that the gain can be 1.0 times in comparison to the luminance signal of the input vide signal in the minimum video unit group $A4_1$. Further, third, fourth and fifth groups of fields in the respective video blocks A4 are set as another minimum video unit group $A4_2$, and the gain control value of each field is set in the variation controller 47 so that the gain can be 0.9 times in comparison to the luminance signal of the input vide signal in the minimum video unit group $A4_2$.

The variation controller 47 recognizes the respective video blocks A4 based on the count values counted up by the cyclic counter 45a, and determines the field positions in the respective video blocks A4. Further, the variation controller 47 determines if the relevant field is included in the minimum video unit group $A4_1$ or in the minimum video unit group $A4_2$ based on the determined field positions, and sets the gain

control value based on a result of the determination.

The variation controller 47 sets the gain control value by repeating the foregoing control routine. Below is given a more detailed description.

A correspondence relation between the count value of the cyclic counter 45a and the gain adjustment amount of the gain controller 46 is previously set based on the setting of the minimum video unit groups $A4_1$ and $A4_2$. The variation controller 47 memorizes the correspondence relation between the set gain adjustment amount and count value (minimum video unit groups $A4_1$ and $A4_2$). In the case of adjusting the luminance in accordance with the 2:3 pull-down method, the correspondence relation memorized by the variation controller 47 is as follows. In the case of the minimum video unit groups $A4_1$ showing count values (1) and (2), the variation controller 47 sets the gain adjustment amount of 1.0 times. In the case of the minimum video unit groups $A4_2$ showing count values (3), (4) and (5), the variation controller 47 sets the gain adjustment amount of 0.9 times. The foregoing control routine is repeated so that the gain adjustment amounts are set.

The gain controller 46 actually controls the gain in accordance with the gain control value set by the variation controller 47. More specifically, the gain controller 46 multiplies the luminance signal of the 60I input video signal 22 outputted from the selector 44 by the set gain control value to thereby change the gain of the video signal. Thus, the gain of the luminance signal is controlled for every two fields and three fields corresponding to the 2:3 pull-down cycle.

Next is described a control operation in the case of generating in the pseudo manner the film image effects based on the 2:3 pull-down cycle referring to Fig. 7.

The control operation in the present case is basically

the same as in the case of generating in the pseudo manner the film image effects based on the 2:3 pull-down cycle, and the description of any part and control that are the same is omitted.

The cyclic counter 45a of the memory controller 45 repeatedly counts ten fields of 1 - 10. The cyclic counter 45a repeatedly provides count values of 1 - 10 for the respective fields constituting the 60I input vide signal 62 inputted to the input terminal 41 for the 60I video signal.

The count values of the cyclic counter 45a showing the fields to be written in the field memory 43 are previously set, and the memory controller 45 memorizes the set count values to be written. In the case of attaining the film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner, the count values to be written are (1), (3), (6) and (9).

The memory controller 45 outputs the instruction for writing the 60I input video signal 52 to the field memory 43 at such a timing that the count value of the 60I input video signal 52 supplied by the cyclic counter 45a is the count value showing the field to be written. The instruction for writing the 60I input video signal 52 is supplied to the field memory 43 as the write control signal 63 with respect to the field memory shown in Fig. 6.

The count values of the cyclic counter 45a showing timings of the read operation with respect to the field memory 43 are previously set, and the memory controller 45 memorizes the set count values showing the timings of the read operation. In the case of imparting the film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner, the count values showing the timings of the read-operation are (2), (4), (5), (7), (8) and (10).

The memory controller 45 outputs the instruction for the

read operation to the field memory 43 at such a timing that the count value supplied by the cyclic counter 45a is the count value showing the timing of the read operation. The instruction for the read operation is supplied to the field memory 43 as the read control signal 64 with respect to the field memory shown in Fig. 7.

In the case of imparting the film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner, for example, at such timings that the count value of the cyclic counter 45a shows (1), (3), (6) and (9), the memory controller 45 instructs the write of the 60I input video signal 62 with respect to the field memory 43. At such timings that the count value of the cyclic counter 45a shows (2), (4), (5), (7), (8) and (10), the memory controller 45 instructs the read operation with respect to the field memory 43.

The output selection by the selector 44 is controlled by the count value of the cyclic counter 45a. A linkage between the count value of the cyclic counter 45a and the output selection of the selector 44 is previously set, and the memory controller 45 memorizes the set linkage.

The 60I input video signal 52 and the output read from the field memory 43 are inputted to the selector 44. The memory controller 45 controls the selector 44 based on the field count value of the 60I input video signal 52 supplied by the cyclic counter 45a. More specifically, the memory controller 45 controls the selector 44 so that the 60I input video signal 52 and the output read from the field memory 43 are selectively outputted.

In the case of imparting the film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner, the linkage memorized by the selector 44 is as follows. The selector 44 selects the 60I input video signal 62 inputted to the input terminal 41 for the 60I video signal when the count values are

(1), (3), (6) and (9), while selecting the output read from the field memory 43 when the count values are (2), (4), (5), (7), (8) and (10).

Therefore, at such timings that the write operation is being executed to the field memory 43 (at such timings that the count value of the cyclic counter 45a shows (1), (3), (6) and (9)), the selector 44 selects the 60I input video signal 62 from the input terminal 41 and outputs it. At such timings that the read operation is being executed to the field memory 43 (at such timings that the count value of the cyclic counter 45a shows (2), (4), (5), (7), (8) and (10)), the selector 44 selects the output from the field memory 43 and outputs it. Thereby, the selector 44 repeatedly outputs the 60I video signal already written in the field memory 43 until the write of the next video signal is executed as shown in the video signal 65 outputted from the selector in Fig. 7.

The variation controller 47 sets the gain control value with respect to the gain controller 46 based on the frame synchronous signal of the 60I input video signal 52 inputted to the input terminal 42. At the time, the variation controller 47 changes the gain control value per field, and sets the gain control value so that the gain control value is changed when the video signal outputted from the selector 44 is different to the video signal of the field immediately before. Below is given a more detailed description.

In the case of imparting the film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner, the variation controller 47 sets video blocks A5 each comprising five fields.

As shown in the control value (gain) 66 in Fig. 7, in the respective video blocks A5 (each comprising the ten fields) constituting the 60I input video signal 62, first, second, sixth, seventh and eighth groups of fields are set as a minimum video

the timings generated by the two cyclic counters correspond to each other.

In the present embodiment, the luminance (gain) may be adjusted based on the cycle of 1/30 second in the same manner as described in the embodiment 1.

According to the description of the embodiment 2, a device constitution comprising the gain controller 46 and the variation controller 47 (hereinafter, referred to as first constitution B1) is provided on a rear-stage side in a signal-transmission direction relative to a device constitution comprising the field memory 43, the selector 44 and the memory controller 45 (hereinafter, referred to as second constitution B2). However, as shown in Fig. 5, the second constitution B2 may be provided on a former-stage side in the signal-transmission direction relative to the first constitution B1.

EMBODIMENT 3

In the described embodiments 1 and 2, the present invention was applied to the device constitution in which the film image effects were generated in the 60I video signal in the pseudo manner. In an embodiment 3 of the present invention, the present invention is applied to a device constitution in which film image effects are generated in the 50I video signal (PAL video signal) in the pseudo manner.

Fig. 8 shows a video signal processing device according to the present embodiment. Fig. 9 is a timing chart showing a status of an image conversion.

Referring to reference numerals shown in Fig. 8, 110 denotes an input terminal for the 50I video signal, 120 denotes an input terminal for a frame synchronous signal of the 50I

the case of the minimum video unit groups $A6_1$ showing count values (1) and (2), the variation controller 130 sets the gain adjustment amount of 1.0 times. In the case of the minimum video unit groups $A6_2$ showing count values (3) and (4), the variation controller 130 sets the gain adjustment amount of 0.9 times. The control routine is repeated so that the gain adjustment amounts are set.

The gain controller 140 actually controls the gain in accordance with the gain control value set by the variation controller 130. More specifically, the gain controller 140 multiplies the luminance signal of the 50I input video signal 220 inputted from the input terminal 110 for the 50I video signal by the set gain control value to thereby change the gain of the video signal. Thus, the gain of the luminance signal is controlled for every two fields and two fields (see Fig. 9).

Thereby, even when the input video signal is 50I video signal, the output video signal thereof (50I video signal) can be vested with the film image effects in the pseudo manner.

In the foregoing case, the cycle in which the luminance (gain) is changed (cycle in which the flickers are generated) is 1/25 second, which is slightly shorter than 1/24 second as the originally desired cycle in which the luminance (gain) is changed, though the projected image having the frame rate of 25 frames per second can be displayed in the state where the flickers are generated. However, because a difference between the cycles is relatively small, the control operation according to the present embodiment can achieve the visual effects corresponding to those obtained from the 24P video signal. Further, in the present embodiment, the luminance (gain) variation point completely corresponds to the frame variation point, which can avoid any visual problem.

In the described embodiments 1 - 3, the flickers are generated in such a manner that the gain is changed to be 1.0

and located within the frame are generated. To be more specific about the location of the variation point of the luminance signal within the frame, the variation point of the luminance is located between the fields constituting the same frame. The location of the variation point within the frame leads to a luminance difference between the fields constituting the same frame, and a projected image thereby obtained gives the viewer the visual problem. Therefore, it is preferable that the location of the variation point of the luminance within the frame be avoided as often as possible.

However, in the case of applying the present invention to the interlace signal so that the film image effects can be generated in the pseudo manner, in particular, it is not possible to avoid the state where the variation point of the luminance is located within the frame. The possibility of such a location of the variation point of the luminance that causes the visual problem can be minimized in the following manner.

In the case of imparting the film image effects can be generated in the pseudo manner according to the present invention, it can be assumed that the bundle of video blocks each equivalent to a second, which was mentioned earlier, are continuously arranged in the video signal. In the case of generating the film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner, six of the video blocks A2 (10 fields) constitute the bundle of video signals each equivalent to a second, the bundle of video blocks A2 are continuously placed in the 60I video signal.

Fig. 10 shows a control state of the video signal in the case of applying the present invention to the 60I video signal so that the film image effects are generated based on the 2:3:3:2 pull-down cycle in the pseudo manner. In the drawing, (a) denotes a state where the bundle of video blocks each equivalent to a second synchronize with the frame period in the case of

generating the film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner. (b) denotes a state where the bundle of video blocks each equivalent to a second does not synchronize with the frame period in the case of generating the film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner.

As shown in Fig. 10, in the case of imparting the film image effects based on the 2:3:3:2 pull-down cycle in the pseudo manner, and when the bundle of video blocks each equivalent to a second does not synchronize with the frame period, the state where the variation point of the luminance is located within the frame is generated 18 times per second. In contrast to that, when the bundle of video blocks each equivalent to a second synchronize with the frame cycle, the state where the variation point of the luminance is located within the frame is generated 6 times per second, which is reduced to 1/3.

As is clear from the foregoing description, in the case of applying the present invention to the 60I video signal so that the film image effects are generated based on the 2:3:3:2 pull-down cycle in the pseudo manner, the state where the variation point of the luminance is located within the frame can be less frequently generated when the bundle of video blocks each equivalent to a second synchronize with the frame period.

The control operation shown in Fig. 10, which exerts such an effect, can be implemented, not only when the film image effects are generated based on the 2:3:3:2 pull-down cycle in the pseudo manner, but also when the present invention is applied to the 50I video signal described in the embodiment 3 referring to Fig. 9 and when the

WHAT IS CLAIMED IS:

1. A video signal processing device comprising:

a gain controller for gain-controlling a digitalized video signal per minimum video unit thereof; and

a variation controller for setting video blocks each comprising a plurality of minimum video units and setting a gain control value of the gain controller to a predetermined value previously memorized of the gain controller in each of the minimum video units constituting the set video blocks, wherein

the gain controller serially divides the video signals into the video blocks and periodically controls the gains of the respective minimum video units constituting the respective video blocks resulting from the division based on the gain control values.

2. A video signal processing device comprising:

a gain controller for gain-controlling a digitalized video signal per minimum video unit; and

a variation controller for setting video blocks each comprising a plurality of minimum video units and setting a gain control value of the gain controller in each the minimum video units constituting the set video blocks, wherein

the gain controller serially divides the video signals into the video blocks and gain-controls the respective minimum video units constituting the respective video blocks resulting from the division based on the gain control values, wherein

the variation controller sets a plurality of groups of minimum video units each comprising at least a minimum video unit in the respective video blocks and sets the gain control value in each of the groups of minimum video units.

3. The video signal processing device as claimed in Claim 2, wherein

the video signal is an interlace video signal whose frame

period is 1/30 second and minimum video unit is a field, and

the variation controller sets the respective video blocks to include five fields, and the variation controller further sets one of the groups of minimum video units to include first and second fields of the video blocks and sets the other of the groups of minimum video units to include third, fourth and fifth fields of the video blocks.

3. The video signal processing device as claimed in Claim 2, wherein

the video signal is an interlace video signal whose frame period is 1/30 second and minimum video unit is a field, and

the variation controller sets the respective video blocks

of the video blocks, and

the memory controller instructs the memory to read the data stored therein and instructs the selector to selectively output the read output of the memory at input timings of second, fourth, fifth, seventh, eighth and tenth fields of the video blocks.

12. The video signal processing device as claimed in Claims 4, 5 and 6, wherein

the variation controller synchronizes a bundle of video blocks each equivalent to a second with a frame period of the video signal.

13. The video signal processing device as claimed in Claim 1, wherein

the variation controller sets two gain control values having values different to each other, and

the gain controller periodically changes the gains of the respective minimum video units by alternately setting the two gain control values having values different to each other in accordance with the period of the control.